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Passenger Car Hydrocarbon Emissions Speciation

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Emission factors for over 60 individual hydrocarbon compounds were determined for four passenger cars. The cars included a 1963 Chevrolet, a 1977 Mustang, a 1978 Monarch, and 1979 LTD II. The speciation data is reported for both tailpipe and evaporative emissions. The tailpipe emissions were for the urban driving conditions of the Federal Test Procedure used in motor vehicle certification. The evaporative emissions were for both diurnal and hot soak conditions, also prescribed in the Federal Test Procedure for certification. The vehicle tests involved four gasoline fuels of varying composition.

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May 1980

PASSENGER CAR HYDROCARBON EMISSIONS SPECIATION

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FORWARD

Air quality criteria exist for ozone and other photochemical oxidants. These compounds are formed by a complex chain of reactions in the atmosphere involving hydrocarbons and other source pollutants. The Environmental Sciences Research Laboratory contributes to the understanding of atmospheric photochemistry through programs engaged in

- examination of the time resolved, concentrations of the chemical reactants and products in the atmosphere, and
- definition of mathematical models permitting computer simulation of the photochemical system, and
- determination of source emission factors for the ozone and oxidant precursors.

This document reports individual hydrocarbon emission factors for passenger car tailpipe and evaporative sources. Reaction rates of the hydrocarbon compounds in the photochemical system vary with chemical structure. Speciation data is thus necessary input to the mathematical models used to predict atmospheric ozone peak concentrations.

A. E. Ellison
Director
Environmental Sciences
Research Laboratory

PREFACE

Detailed hydrocarbon emissions inventories for passenger cars are not abundant in the literature, particularly so for evaporative sources. Care must be exercised when applying the available data. Speciation of hydrocarbon emissions is sensitive to many variables, e.g., fuel composition, emissions control configuration, driving patterns, and ambient temperature. The limited reported studies have examined limited ranges of these important variables. The data reported in this document describe hydrocarbon emissions from four passenger cars, for one driving pattern, under summer temperature conditions. Four fuels were used in the study. Extrapolation from a limited data base to vehicle fleet emissions character is difficult.

Evaporative and tailpipe hydrocarbon emissions have significantly different speciation. Further, they are emitted under different operating conditions. Evaporative emissions from recent generation passenger cars are inconsequential while the vehicle is being operated over the highway. Thus, evaporative speciation will be important to urban grid areas dominated by parking lots and tailpipe speciation to those dominated by moving vehicles on streets and highways. Fuel composition is very important to emissions speciation of hydrocarbons of the molecular weight of butane and higher. Typically, marketed gasolines will vary in aromatic hydrocarbon content from 20 to 50 percent. This is a primary source of variability between reported emissions factors for individual hydrocarbons and those in actual urban areas. Tailpipe hydrocarbon speciation also varies significantly with emissions control configuration.

When attempting to define the composition of hydrocarbon emissions from passenger cars in urban areas, extrapolation from the literature must consider fuel composition, vehicle configurations, driving patterns, and ambient conditions.

ABSTRACT

Emission factors for over 60 individual hydrocarbon compounds were determined for four passenger cars. The cars included a 1963 Chevrolet, 1977 Mustang, 1978 Monarch, and 1979 LTD-II. The speciation data is reported for both tailpipe and evaporative emissions. The tailpipe emissions were for the urban driving conditions of the Federal Test Procedure used in motor vehicle certification. The evaporative emissions were for both diurnal and hot soak conditions, also prescribed in the Federal Test Procedure for certification. The vehicle tests involved four gasoline fuels of varying composition.

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Note: In Tables 4 through 11, line 16 N-pentene should read N-pentane.

INTRODUCTION

Emission rates of over 60 individual hydrocarbon compounds have been determined for four passenger cars including a 1963 Chevrolet, 1977 Mustang, 1978 Monarch, and 1979 LTD-II. Vehicle specifications are given in TABLE 1. These vehicles are representative of a wide range of emissions control configurations. The rates were determined for both tailpipe and evaporative emissions. Four gasoline fuels were used, specifications for which are reported in TABLE 2. The vehicle test procedures were as required for emissions certification (1). Figure 1 presents a graphic flow diagram of the vehicle test sequence.

TABLE 1. TEST VEHICLE SPECIFICATIONS.

Vehicle	Engine	Mileage	Test inertia wt.	Emission control
1963 Chevrolet	283V8	66,500	3000	PCV
1977 Mustang	302V8	10,000	3000	EGR/CAT/PCV/fuel tank canister
1978 Monarch	302V8	10,000	3500	EGR/AIR/CAT/PCV/carb & fuel tank canister[a]
1979 LTD-II	351V8	10,000	4500	EGR/AIR/CAT/PCV/carb & fuel tank canisters[b]

[a] A single canister used for control of both fuel tank and carburetor emissions.

[b] Two canisters, one each for the fuel tank and carburetor, used for control of emissions.

This document is for the purpose of reporting individual hydrocarbon emission rates. The impact of the emission control devices used with the test vehicles on emission rates and patterns, and the sensitivity of emissions to fuel composition has been presented elsewhere (2).

TABLE 2. TEST FUEL SPECIFICATIONS.

FUEL	A	B	C	D[a]
RVP	8.4	9.8	12.3	12.8
API gravity	61.6	54.9	62.0	62.3
Distillation, °F				
10%	133	126	114	108
50%	207	219	219	217
90%	285	327	362	347
EP	376	369	410	418
Hydrocarbon, wt. %[b]				
n-butane	3.73	3.48	9.94	9.85
i-pentane	6.94	11.19	7.85	8.15
n-pentane	5.48	3.40	4.13	4.08
benzene	0.28	1.52	1.95	1.83
toluene	17.55	27.91	6.30	6.01
paraffinic	65.4	49.0	67.0	69.0
olefinic	7.2	7.6	7.0	5.1
aromatic	27.4	43.4	25.7	25.9

[a] Leaded gasoline 1.98 g/gal.
[b] Analysis by gas chromatography.

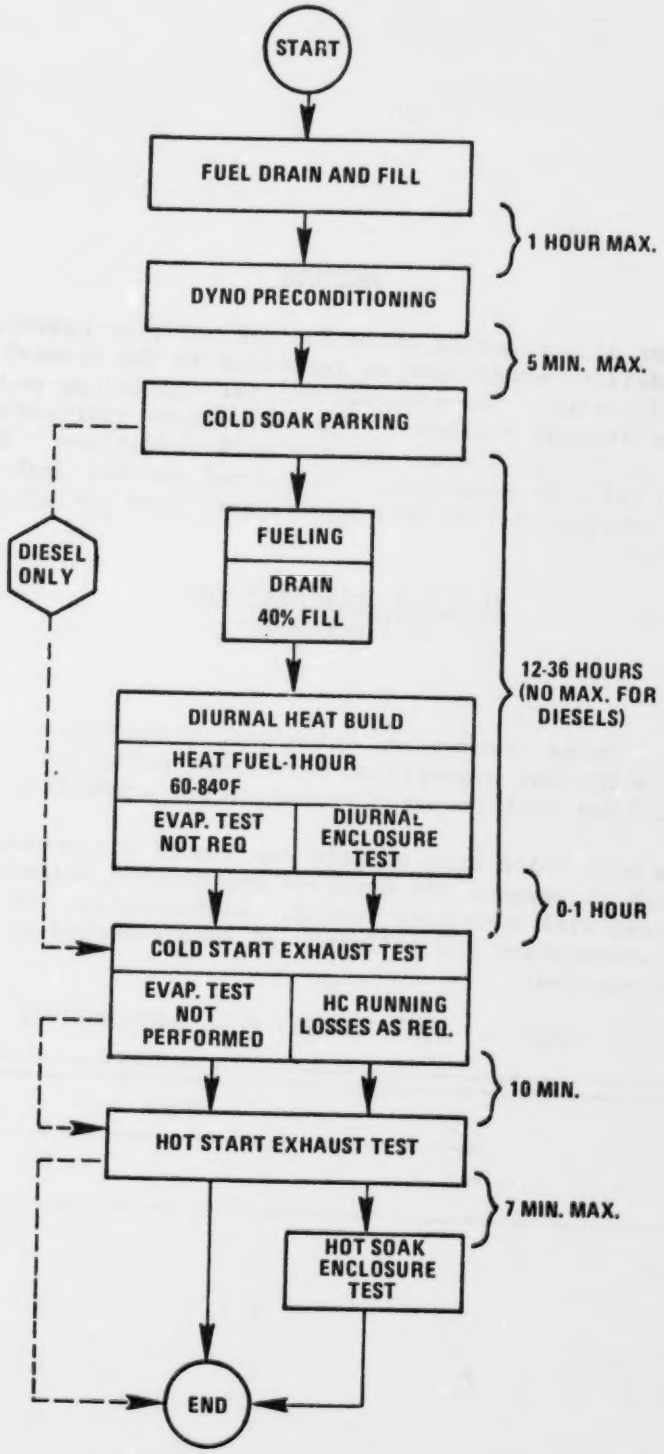

Figure 1. Vehicle emissions test sequence.

RESULTS

The gram per mile emission rates for the tailpipe hydrocarbon compounds were for urban driving conditions as specified in the Federal Register for emissions certification. The evaporative test conditions were also as specified in the Federal Register. The evaporative hydrocarbon composition was determined under both diurnal and hot soak conditions. To permit direct comparison with tailpipe emissions, the diurnal and hot soak emissions were combined as in equation (1) to give equivalent "gram per mile" evaporative hydrocarbon rates (3).

$$\text{Evap} = \frac{\text{Di} + 3.3 \text{ trips/day (Hs)}}{29.4 \text{ miles/day}} \qquad (1)$$

where:

Evap = Total evaporative emissions, grams/mile
Di = Diurnal evaporative emissions, grams/day
Hs = Hot soak evaporative emissions, grams/trip.

The fuels with which each vehicle was tested are presented in TABLE 3. TABLES 4 through 11 present the detailed hydrocarbon emissions speciation for each vehicle, with each fuel tested. Additionally, the percentage contribution, evaporative and tailpipe, of each compound to the vehicle aggregate is presented.

TABLE 3. VEHICLE-TEST FUEL COMBINATIONS.

	FUEL			
Vehicle	A	B	C	D
1963 Chevrolet				X
1977 Mustang		X	X	
1978 Monarch	X	X	X	
1979 LTD-II		X	X	

TABLE 4. HYDROCARBON EMISSION PATTERNS: 1963 CHEVROLET, FUEL D

Compound	Tailpipe g/mi	% of THC	Evaporative Di,g	Evaporative HS,g	Evaporative Total g/mi	% of THC
Methane	0.4103	4.27				
Ethylene	0.5424	5.65				
Ethane	0.0778	0.81				
Acetylene	0.3820	3.98				
Propylene; propane	0.2297	2.39				
Propadiene	0.0125	0.13				
Methyl acethylene acetylene	0.0290	0.30				
Isobutane	0.0197	0.21	3.3170	1.7502	0.3164	3.30
Butene 1; isobutylene	0.0935	0.97	0.3950	0.2299	0.0401	0.42
N-butane; 1, 3-butadiene	0.2023	2.11	18.6139	12.1127	2.0303	21.15
Trans-2-butene	0.0153	0.16	0.6710	0.4265	0.0719	0.75
Cis-2-butene	0.0169	0.18	0.4090	0.2759	0.0457	0.48
3-methyl-1-butene	0.0040	0.04	0.0676	0.0607	0.0089	0.09
Isopentane	0.1253	1.31	6.3254	6.3742	0.9424	9.82
Pentene-1	0.0089	0.09	0.1847	0.1944	0.0290	0.30
N-pentene; 2-methyl-1-butene	0.0758	0.79	2.3592	2.7232	0.3899	4.06
Trans-2-pentene	0.0129	0.13	0.3791	0.4472	0.0641	0.67
Cis-2-pentene	0.0181	0.19	0.4906	0.6072	0.0858	0.89
2,2 Dimethylbutane	0.0121	0.13	0.1120	0.1519	0.0212	0.22
Cyclopentene	0.0040	0.04	0.1231	0.1504	0.0217	0.23
Cyclopentane; 3-methyl-1-pentene	0.0093	0.10	0.1919	0.2570	0.0362	0.38
2,3-dimethylbutane	0.0214	0.22	0.3480	0.5436	0.0735	0.77
2-methylpentane; 2,3-dimethly-1-butene	0.0613	0.64	0.9091	1.5220	0.2033	2.12
3-methylpentane	0.0359	0.37	0.4724	0.8265	0.1097	1.14
1-hexene; 2-ethyl-1-butene	0.0093	0.10	0.0761	0.1289	0.0173	0.18
N-hexane; Cis-3-hexene	0.0383	0.40	0.3980	0.7659	0.1003	1.04
2 methyl-2-pentene	0.0101	0.11	0.1038	0.1969	0.0262	0.27
Methylcyclopentane; 3-methyltrans-2-pentene	0.0282	0.29	0.2752	0.5369	0.0702	0.73
2,4-dimethylpentane	0.0250	0.26	0.1726	0.3788	0.0490	0.51
Methylcyclopentene	0.0004	0.00	0.0022	0.0045	0.0006	0.01
Benzene	0.1539	1.60	0.1334	0.2486	0.0329	0.34
Cyclohexene; 2,3-dimethylpentane; 2-methylhexane	0.0629	0.66	0.2968	0.7417	0.0941	0.98
3-methylhexane, cyclohexane	0.0399	0.42	0.2699	0.6457	0.0824	0.86
Isooctane	0.0887	0.92	0.3062	0.8333	0.1047	1.09
N-heptane	0.0270	0.28	0.1004	0.2869	0.0362	0.38
2,4,4 Trimethyl-1-pentene	0.0032	0.03	0.0138	0.0377	0.0050	0.05
Methylcyclohexane	0.0165	0.17	0.0575	0.1588	0.0201	0.21
1 Cis-4-dimethylcyclohexane	0.0024	0.03	0.0079	0.0220	0.0028	0.03
2,4 and 2,5-dimethylhexane	0.0306	0.32	0.0674	0.2126	0.0262	0.27
2,3,4-trimethylpentane	0.0294	0.31	0.0385	0.1258	0.0156	0.16
2,3,3-trimethylpentane	0.0133	0.14	0.0663	0.2100	0.0262	0.27
Toluene; 2,3-dimethylhexane	0.2067	2.15	0.2510	0.7419	0.0925	0.96
2-methylheptane	0.0258	0.27	0.0430	0.1444	0.0178	0.19
3-methylheptane	0.0218	0.23	0.0365	0.1263	0.0156	0.16
2,2,5-trimethylhexane	0.0177	0.18	0.0325	0.1024	0.0128	0.13
N-octane	0.0185	0.19	0.0282	0.0765	0.0095	0.10
2,3,5-trimethylhexane	0.0032	0.03	0.0045	0.0158	0.0022	0.02
2,4-dimethylheptane	0.0028	0.03	0.0038	0.0147	0.0022	0.02
2,5 and 3,5-dimethylheptane	0.0069	0.07	0.0060	0.0239	0.0028	0.03
Ethylbenzene; 2,3-dimethylheptane	0.0488	0.51	0.0283	0.0990	0.0123	0.13
P-xylene; x-xylene; 4-methyloctane	0.1632	1.70	0.0973	0.3367	0.0418	0.44
3 methyl octane	--	--	--	--	--	--
O-xylene; unk C_9 paraffin	0.0838	0.87	0.0368	0.1323	0.0167	0.17
Nonane	0.0125	0.13	0.0102	0.0285	0.0033	0.03
N-propylbenzene	0.0129	0.13	0.0068	0.0299	0.0039	0.04
1-methyl 3-ethyl-benzene; unk C_{10}paraffin	0.0774	0.81	0.0320	0.1254	0.0156	0.16
1-methyl 2-ethyl benzene	--	--	--	--	--	--
Mesitylene	0.0367	0.38	0.0210	0.0728	0.0089	0.09
2,6 dimethyl octane	0.0294	0.31	0.0152	0.0533	0.0067	0.07
1,2,4-trimethylbenzene	0.0923	0.96	0.0376	0.1291	0.0162	0.17
Secbutylbenzene; n-decane	0.0222	0.23	0.0093	0.0344	0.0045	0.05
Unknowns	0.1479	1.54	0.3448	0.4375	0.0941	0.98
TOTAL:	4.03	41.98	38.8	37.2	5.57	58.02

TABLE 5. HYDROCARBON EMISSION PATTERNS: 1977 FORD MUSTANG II, FUEL B

Compound	Tailpipe g/mi	% of THC	Evaporative Di,g	Evaporative HS,g	Evaporative Total g/mi	% of THC
Methane	0.2440	4.51				
Ethylene	0.2053	3.79				
Ethane	0.0489	0.90				
Acetylene	0.0041	0.06				
Propylene; propane	0.0720	1.33				
Propadiene	0.0006	0.01				
Methyl acethylene acetylene	0.0011	0.02				
Isobutane	0.0144	0.27	0.0032	0.5893	0.0663	1.23
Butene 1; isobutylene	0.0464	0.86	0.0020	0.1240	0.0138	0.26
N-butane; 1, 3-butadiene	0.0776	1.43	0.0378	2.8137	0.3169	5.86
Trans-2-butene	0.0149	0.26	0.0034	0.2147	0.0241	0.46
Cis-2-butene	0.0105	0.19	0.0027	0.1777	0.0201	0.37
3-methyl-1-butene	0.0019	0.04	0.0008	0.0613	0.0069	0.13
Isopentane	0.2018	3.73	0.0761	6.7182	0.7563	13.98
Pentene-1	0.0030	0.06	0.0025	0.1971	0.0223	0.41
N-pentene; 2-methyl-1-butene	0.0632	1.17	0.0247	1.8612	0.2096	3.87
Trans-2-pentene	0.0080	0.15	0.0074	0.4810	0.0543	1.00
Cis-2-pentene	0.0155	0.29	0.0109	0.7431	0.0837	1.55
2,2 Dimethylbutane	0.0047	0.09	0.0009	0.0824	0.0093	0.17
Cyclopentene	0.0028	0.05	0.0010	0.0782	0.0087	0.16
Cyclopentane; 3-methyl-1-pentene	0.0061	0.11	0.0040	0.5535	0.0623	1.15
2,3-dimethylbutane	0.0199	0.37	0.0087	0.4646	0.0525	0.97
2-methylpentane; 2,3-dimethly-1-butene	0.0560	1.04	0.0166	1.1270	0.1272	2.35
3-methylpentane	0.0306	0.57	0.0074	0.5313	0.0599	1.11
1-hexene; 2-ethyl-1-butene	0.0039	0.07	0.0029	0.1568	0.0178	0.33
N-hexane; Cis-3-hexene	0.0130	0.24	0.0032	0.1886	0.0212	0.39
2 methyl-2-pentene	0.0102	0.19	0.0035	0.2557	0.0289	0.53
Methylcyclopentane; 3-methyltrans-2-pentene	0.0232	0.43	0.0073	0.4026	0.0453	0.84
2,4-dimethylpentane	0.0132	0.24	0.0028	0.1605	0.0183	0.34
Methylcyclopentene	--	--	--	0.0052	0.0005	0.01
Benzene	0.2887	5.34	0.0143	0.4122	0.0469	0.87
Cyclohexene; 2,3-dimethylpentane; 2-methylhexane	0.0279	0.52	0.0061	0.2689	0.0305	0.56
3-methylhexane, cyclohexane	0.0218	0.40	0.0041	0.1775	0.0201	0.37
Isooctane	0.0607	1.12	0.0087	0.3892	0.0440	0.81
N-heptane	0.0091	0.17	0.0041	0.1253	0.0143	0.26
2,4,4 Trimethyl-1-pentene	0.0008	0.01	0.0006	0.0336	0.0037	.07
Methylcyclohexane	0.0102	0.19	0.0009	0.0780	0.0087	0.16
1 Cis-4-dimethylcyclohexane	0.0019	0.04	--	--	--	--
2,4 and 2,5-dimethylhexane	0.0257	0.48	0.0023	0.1360	0.0154	0.28
2,3,4-trimethylpentane	0.0560	1.04	0.0066	0.2762	0.0313	0.58
2,3,3-trimethylpentane	--	---	--	--	--	--
Toluene; 2,3-dimethylhexane	0.5727	10.59	0.1241	1.9266	0.2202	4.07
2-methylheptane	0.0105	0.19	0.0003	0.0520	0.0058	0.11
3-methylheptane	0.0086	0.16	0.0019	0.0280	0.0032	0.06
2,2,5-trimethylhexane	0.0279	0.52	0.0027	0.0408	0.0048	0.09
N-octane	0.0052	0.10	0.0013	0.1269	0.0143	0.26
2,3,5-trimethylhexane	0.0041	0.08	0.0008	0.0101	0.0011	0.02
2,4-dimethylheptane	0.0014	0.03	0.0004	0.0029	0.0003	0.01
2,5 and 3,5-dimethylheptane	0.0030	0.06	-0.0001	0.0065	0.0005	0.01
Ethylbenzene; 2,3-dimethylheptane	0.0317	0.59	0.0038	0.0439	0.0048	0.09
P-xylene; x-xylene; 4-methyloctane	0.0856	1.58	0.0143	0.1157	0.0135	0.25
3 methyl octane	--	--	--	--	--	--
O-xylene; unk C_9 paraffin	0.0411	0.76	0.0026	0.0464	0.0053	0.10
Nonane	0.0044	0.08	-0.0011	0.0040	0.0005	0.01
N-propylbenzene	0.0094	0.17	0.0023	0.0184	0.0021	0.04
1-methyl 3-ethyl-benzene; unk C_{10}paraffin	0.0558	1.03	0.0121	0.3373	0.0384	0.71
1-methyl 2-ethyl benzene	0.0063	0.12	--	--	--	--
Mesitylene	0.0301	0.56	0.0025	0.1430	0.0162	0.30
2,6 dimethyl octane	0.0210	0.39	0.0006	0.1186	0.0133	0.25
1,2,4-trimethylbenzene	0.0751	1.39	0.0140	0.0638	0.0077	0.14
Secbutylbenzene; n-decane	0.0127	0.23	0.0015	0.0156	0.0016	0.03
Unknowns	0.0395	0.73	0.0145	0.04958	0.0562	1.04
TOTAL:	2.76	51.02	.48	23.48	2.65	48.98

TABLE 6. HYDROCARBON EMISSION PATTERNS: 1977 FORD MUSTANG II, FUEL C

Compound	Tailpipe g/mi	% of THC	Evaporative Di,g	HS,g	Total g/mi	% of THC
Methane	0.2730	4.26				
Ethylene	0.2957	4.61				
Ethane	0.0680	1.06				
Acetylene	0.0073	0.11				
Propylene; propane	0.1067	1.66	0.0112	0.0283		
Propadiene	0.0006	0.01				
Methyl acethylene acetylene	0.0011	0.02				
Isobutane	0.0227	0.35	0.0121	0.8552	0.0971	1.51
Butene 1; isobutylene	0.0490	0.76	0.0024	0.1697	0.0191	0.30
N-butane; 1, 3-butadiene	0.2069	3.23	0.0812	8.4647	0.9538	14.88
Trans-2-butene	0.0188	0.29	0.0037	0.4061	0.0448	0.70
Cis-2-butene	0.0132	0.21	0.0024	0.2539	0.0289	0.45
3-methyl-1-butene	0.0022	0.03	0.0009	0.0860	0.0097	0.15
Isopentane	0.1417	2.21	0.0457	5.4489	0.6169	9.62
Pentene-1	0.0056	0.09	0.0027	0.3216	0.0365	0.57
N-pentene; 2-methyl-1-butene	0.0776	1.27	0.0224	2.5851	0.2928	4.57
Trans-2-pentene	0.0090	0.14	0.0058	0.6698	0.0762	1.19
Cis-2-pentene	0.0098	0.15	0.0075	0.9011	0.1022	1.59
2,2 Dimethylbutane	0.0053	0.08	0.0014	0.1764	0.0199	0.31
Cyclopentene	0.0034	0.05	0.0010	0.0972	0.0112	0.17
Cyclopentane; 3-methyl-1-pentene	0.0154	0.24	0.0048	0.2205	0.0253	0.39
2,3-dimethylbutane	0.0244	0.38	0.0057	0.5763	0.0653	1.02
2-methylpentane; 2,3-dimethly-1-butene	0.0638	1.00	0.0124	1.5090	0.1708	2.66
3-methylpentane	0.0414	0.66	0.0073	0.8133	0.0921	1.44
1-hexene; 2-ethyl-1-butene	0.0045	0.07	0.0025	0.1701	0.0195	0.30
N-hexane; Cis-3-hexene	0.0302	0.47	0.0047	0.5255	0.0563	0.88
2 methyl-2-pentene	0.0042	0.07	0.0054	0.2561	0.0292	0.46
Methylcyclopentane; 3-methyltrans-2-pentene	0.0358	0.56	0.0075	0.6801	0.0773	1.21
2,4-dimethylpentane	0.0286	0.45	0.0037	0.3695	0.0419	0.65
Methylcyclopentene	--	--	--	0.0024	0.0007	0.01
Benzene	0.1896	2.98	0.0093	0.5169	0.0588	0.92
Cyclohexene; 2,3-dimethylpentane; 2-methylhexane	0.0683	1.07	0.0089	0.7583	0.0859	1.34
3-methylhexane, cyclohexane	0.0482	0.75	0.0071	0.5069	0.0578	0.90
Isooctane	0.1179	1.84	0.0133	0.9802	0.1112	1.73
N-heptane	0.0168	0.26	0.0046	0.2653	0.0303	0.47
2,4,4 Trimethyl-1-pentene	0.0006	0.01	0.0005	0.0239	0.0054	0.08
Methylcyclohexane	0.0140	0.22	0.0030	0.1402	0.0159	0.25
1 Cis-4-dimethylcyclohexane	0.0034	0.05	--	0.0132	0.0029	0.05
2,4 and 2,5-dimethylhexane	0.0328	0.51	0.0050	0.2262	0.0256	0.40
2,3,4-trimethylpentane	0.0501	0.78	0.0095	0.3956	0.0451	0.70
2,3,3-trimethylpentane	0.0134	0.21	--	--	--	--
Toluene; 2,3-dimethylhexane	0.1688	2.63	0.0484	0.6770	0.0783	1.22
2-methylheptane	0.0235	0.37	0.0038	0.1175	0.0137	0.21
3-methylheptane	0.0213	0.33	0.0030	0.1141	0.0130	0.20
2,2,5-trimethylhexane	0.0210	0.33	0.0034	0.0880	0.0101	0.16
N-octane	0.0112	0.17	0.0026	0.0747	0.0087	0.14
2,3,5-trimethylhexane	0.0034	0.05	0.0004	0.0094	0.0011	0.02
2,4-dimethylheptane	0.0034	0.05	0.0003	0.0089	0.0007	0.01
2,5 and 3,5-dimethylheptane	0.0053	0.08	0.0008	0.0172	0.0022	0.03
Ethylbenzene; 2,3-dimethylheptane	0.0286	0.45	0.0037	0.0720	0.0083	0.13
P-xylene; x-xylene; 4-methyloctane	0.1159	1.81	0.0135	0.2661	0.0307	0.48
3 methyl octane	--	--	--	--	--	--
O-xylene; unk C_9 paraffin	0.0540	0.84	0.0061	0.1015	0.0119	0.19
Nonane	0.0104	0.16	0.0018	0.0267	0.0032	0.05
N-propylbenzene	0.0073	0.11	0.0016	0.0284	0.0032	0.05
1-methyl 3-ethyl-benzene; unk C_{10}paraffin	0.0412	0.64	0.0088	0.0934	0.0108	0.17
1-methyl 2-ethyl benzene	--	--	--	--	--	--
Mesitylene	0.0297	0.46	0.0034	0.0611	0.0072	0.11
2,6 dimethyl octane	0.0235	0.36	0.0033	0.0518	0.0058	0.09
1,2,4-trimethylbenzene	0.0512	0.80	0.0089	0.0994	0.0116	0.18
Secbutylbenzene; n-decane	0.0123	0.19	0.0012	0.0164	0.0018	0.03
Unknowns	0.0532	0.83	0.0094	0.6731	0.0762	1.19
TOTAL:	2.80	43.68	.44	32.0	3.61	56.32

TABLE 7. HYDROCARBON EMISSION PATTERNS: 1978 MERCURY MONARCH, FUEL A

Compound	Tailpipe g/mi	% of THC	Evaporative Di,g	Evaporative HS,g	Evaporative Total g/mi	% of THC
Methane	0.1060	8.62	- 0.0001	0.0003		
Ethylene	0.0490	3.98	- 0.0001	0.0001		
Ethane	0.0349	2.84	0.0000	0.0001		
Acetylene	0.0045	0.37	0.0004	0.0002		
Propylene; propane	0.0261	2.12	0.0001	- 0.0002		
Propadiene	0.0009	0.07	--	0.0004		
Methyl acethylene acetylene	0.0002	0.02	--	0.0003		
Isobutane	0.0020	0.16	0.0027	0.0177	0.0021	0.17
Butene 1; isobutylene	0.0169	1.37	--	--	--	--
N-butane; 1, 3-butadiene	0.0570	4.63	0.1239	0.2099	0.0280	2.28
Trans-2-butene	0.0063	0.51	0.0051	0.0031	0.0011	0.09
Cis-2-butene	0.0027	0.22	0.0006	--	0.0000	--
3-methyl-1-butene	0.0005	0.04	0.0001	--	0.0000	--
Isopentane	0.0625	5.08	0.1114	0.2491	0.0316	2.57
Pentene-1	0.0009	0.07	0.0024	0.0022	0.0003	0.02
N-pentene; 2-methyl-1-butene	0.0536	4.36	0.0646	0.1831	0.0225	1.83
Trans-2-pentene	0.0020	0.16	0.0040	0.0083	0.0011	0.09
Cis-2-pentene	0.0075	0.61	0.0061	0.0121	0.0015	0.12
2,2 Dimethylbutane	0.0393	3.20	0.0191	0.0781	0.0093	0.76
Cyclopentene	0.0065	0.53	0.0006	0.0012	0.0002	0.02
Cyclopentane; 3-methyl-1-pentene	0.0712	5.79	0.0656	0.2733	1.0324	2.63
2,3-dimethylbutane	0.0031	0.25	0.0030	0.0178	0.0022	0.18
2-methylpentane; 2,3-dimethly-1-butene	0.0056	0.46	0.0082	0.0210	0.0026	0.21
3-methylpentane	0.0023	0.19	0.0041	0.0089	0.0011	0.09
1-hexene; 2-ethyl-1-butene	0.0010	0.08	0.0010	0.0030	0.0004	0.03
N-hexane; Cis-3-hexene	0.0023	0.19	0.0035	0.0097	0.0012	0.10
2 methyl-2-pentene	0.0025	0.20	0.0026	0.0083	0.0010	0.08
Methylcyclopentane; 3-methyltrans-2-pentene	0.0028	0.23	0.0041	0.0082	0.0011	0.09
2,4-dimethylpentane	0.0026	0.21	0.0021	0.0056	0.0007	0.06
Methylcyclopentene	0.0001	0.01	0.0006	0.0033	0.0004	0.03
Benzene	0.0297	2.41	0.0037	0.0084	0.0011	0.09
Cyclohexene; 2,3-dimethylpentane; 2-methylhexane	0.0354	2.88	0.0015	0.0638	0.0074	0.60
3-methylhexane, cyclohexane	0.0070	0.57	0.0040	0.0144	0.0017	0.14
Isooctane	0.0824	6.70	0.0148	0.0946	0.0108	0.88
N-heptane	0.0084	0.68	0.0029	0.0136	0.0016	0.13
2,4,4 Trimethyl-1-pentene	0.0053	0.43	0.0019	0.0158	0.0018	0.15
Methylcyclohexane	0.0048	0.39	0.0022	0.0085	0.0010	0.08
1 Cis-4-dimethylcyclohexane	0.0023	0.19	0.0008	0.0043	0.0005	0.04
2,4 and 2,5-dimethylhexane	0.0110	0.89	0.0019	0.0123	0.0015	0.12
2,3,4-trimethylpentane	0.0084	0.68	0.0024	0.0135	0.0016	0.13
2,3,3-trimethylpentane	0.0034	0.28	--	--	--	--
Toluene; 2,3-dimethylhexane	0.1164	9.46	0.0212	0.1213	0.0140	1.14
2-methylheptane	0.0123	1.00	0.0047	0.0195	0.0023	0.19
3-methylheptane	0.0117	0.95	0.0040	0.0148	0.0018	0.15
2,2,5-trimethylhexane	0.0028	0.23	0.0005	0.0050	0.0006	0.05
N-octane	0.0088	0.72	0.0019	0.0092	0.0011	0.09
2,3,5-trimethylhexane	0.0011	0.09	--	- 0.0002	--	--
2,4-dimethylheptane	0.0024	0.20	0.0003	0.0016	0.0002	0.02
2,5 and 3,5-dimethylheptane	0.0035	0.28	0.0002	0.0013	0.0002	0.02
Ethylbenzene; 2,3-dimethylheptane	0.0102	0.83	0.0013	0.0059	0.0007	0.06
P-xylene; x-xylene; 4-methyloctane	0.0277	2.25	0.0056	0.0239	0.0028	0.23
3 methyl octane	0.0025	0.20	0.0010	0.0041	0.0005	0.04
O-xylene; unk C_9 paraffin	0.0104	0.85	0.0016	0.0087	0.0010	0.08
Nonane	0.0037	0.30	0.0009	0.0033	0.0004	0.03
N-propylbenzene	0.0033	0.27	0.0006	0.0039	0.0005	0.04
1-methyl 3-ethyl-benzene; unk C_{10}paraffin	0.0068	0.55	0.0019	0.0057	0.0007	0.06
1-methyl 2-ethyl benzene	--	--	--	--	--	--
Mesitylene	0.0057	0.46	0.0013	0.0065	0.0008	0.06
2,6 dimethyl octane	0.0038	0.31	0.0009	0.0019	0.0002	0.02
1,2,4-trimethylbenzene	0.0184	1.50	0.0020	0.0071	0.0009	0.07
Secbutylbenzene; n-decane	0.0026	0.21	0.0007	0.0019	0.0003	0.02
Unknowns	0.0128	1.04	0.0059	0.0153	0.0019	0.15
TOTAL:	1.03	83.74	0.54	1.64	0.20	16.26

TABLE 8. HYDROCARBON EMISSIONS: 1978 MERCURY MONARCH, FUEL B

Compound	Tailpipe g/mi	% of THC	Evaporative Di,g	Evaporative HS,g	Evaporative Total g/mi	% of THC
Methane	0.0852	6.26	0.0062	- 0.0010		
Ethylene	0.0360	2.65	0.0006	0.0001		
Ethane	0.0308	2.26	—	—		
Acetylene	0.0126	0.93	—	—		
Propylene; propane	0.0195	1.43	0.0006	0.0001		
Propadiene	—	—	—	0.0010		
Methyl acethylene acetylene	—	—	—	—		
Isobutane	0.0101	0.74	0.0283	0.0436	0.0058	0.43
Butene 1; isobutylene	0.0107	0.79	—	0.0079	0.0015	0.11
N-butane; 1, 3-butadiene	0.0517	3.80	0.1122	0.2481	0.0311	2.29
Trans-2-butene	0.0040	0.29	0.0069	0.0171	0.0021	0.15
Cis-2-butene	0.0036	0.26	0.0088	0.0197	0.0025	0.18
3-methyl-1-butene	0.0011	0.08	0.0024	0.0086	0.0010	0.07
Isopentane	0.0961	7.07	0.2341	0.8035	0.0955	7.02
Pentene-1	0.0012	0.09	0.0063	0.0210	0.0025	0.18
N-pentene; 2-methyl-1-butene	0.0280	2.06	0.0661	0.2335	0.0277	2.04
Trans-2-pentene	0.0041	0.30	0.0166	0.0614	0.0072	0.53
Cis-2-pentene	0.0071	0.52	0.0270	0.0920	0.0110	0.81
2,2 Dimethylbutane	0.0028	0.21	0.0053	0.0168	0.0020	0.15
Cyclopentene	0.0016	0.12	0.0034	0.0103	0.0013	0.10
Cyclopentane; 3-methyl-1-pentene	0.0027	0.20	0.0086	0.0301	0.0036	0.27
2,3-dimethylbutane	0.0078	0.57	0.0176	0.0571	0.0068	0.50
2-methylpentane; 2,3-dimethly-1-butene	0.0215	1.58	0.0536	0.1706	0.0204	1.50
3-methylpentane	0.0125	0.92	0.0276	0.0825	0.0100	0.74
1-hexene; 2-ethyl-1-butene	0.0018	0.13	0.0080	0.0219	0.0027	0.20
N-hexane; Cis-3-hexene	0.0051	0.38	0.0101	0.0333	0.0039	0.29
2 methyl-2-pentene	0.0048	0.35	0.0253	0.0596	0.0074	0.54
Methylcyclopentane; 3-methyltrans-2-pentene	0.0072	0.53	0.0195	0.0533	0.0065	0.48
2,4-dimethylpentane	0.0053	0.39	0.0166	0.0343	0.0043	0.32
Methylcyclopentene	0.0024	0.18	0.0108	0.0215	0.0027	0.20
Benzene	0.0303	2.23	0.0251	0.0700	0.0085	0.63
Cyclohexene; 2,3-dimethylpentane; 2-methylhexane	0.0105	0.77	0.0248	0.0554	0.0069	0.51
3-methylhexane, cyclohexane	0.0069	0.51	0.0180	0.0351	0.0045	0.33
Isooctane	0.0225	1.65	0.0433	0.0877	0.0111	0.82
N-heptane	0.0045	0.33	0.0138	0.0239	0.0031	0.23
2,4,4 Trimethyl-1-pentene	0.0013	0.10	0.0029	0.0080	0.0010	0.07
Methylcyclohexane	0.0036	0.26	0.0109	0.0193	0.0025	0.18
1 Cis-4-dimethylcyclohexane	0.0004	0.03	0.0016	0.0031	0.0004	0.03
2,4 and 2,5-dimethylhexane	0.0078	0.57	0.0181	0.0322	0.0042	0.31
2,3,4-trimethylpentane	0.0109	0.80	0.0208	0.0284	0.0038	0.28
2,3,3-trimethylpentane	0.0077	0.57	0.0181	0.0460	0.0057	0.41
Toluene; 2,3-dimethylhexane	0.1578	11.62	0.3999	0.7440	0.0954	7.01
2-methylheptane	0.0061	0.45	—	—	0.0032	0.24
3-methylheptane	0.0052	0.38	0.0145	0.0251	—	—
2,2,5-trimethylhexane	0.0139	1.02	0.0225	0.0374	0.0049	0.36
N-octane	0.0032	0.24	0.0055	0.0089	0.0012	0.09
2,3,5-trimethylhexane	0.0018	0.13	0.0035	0.0047	0.0007	0.05
2,4-dimethylheptane	0.0004	0.03	0.0009	0.0013	0.0002	0.01
2,5 and 3,5-dimethylheptane	0.0007	0.05	0.0015	0.0026	0.0003	0.02
Ethylbenzene; 2,3-dimethylheptane	0.0099	0.73	0.0152	0.0222	0.0030	0.22
P-xylene; x-xylene; 4-methyloctane	0.0194	1.43	0.0409	0.0605	0.0081	0.60
3 methyl octane	0.0012	0.09	0.0043	0.0058	0.0008	0.06
O-xylene; unk C_9 paraffin	0.0095	0.70	0.0173	0.0271	0.0036	0.26
Nonane	0.0009	0.07	0.0025	0.0029	0.0004	0.03
N-propylbenzene	0.0041	0.30	0.0111	0.0123	0.0017	0.13
1-methyl 3-ethyl-benzene; unk C_{10}paraffin	0.0170	1.25	0.0359	0.0431	0.0060	0.44
1-methyl 2-ethyl benzene	—	—	—	—	—	—
Mesitylene	0.0080	0.59	0.0172	0.0215	0.0030	0.22
2,6 dimethyl octane	0.0081	0.60	0.0160	0.0197	0.0027	0.20
1,2,4-trimethylbenzene	0.0186	1.37	0.0329	0.0492	0.0066	0.49
Secbutylbenzene; n-decane	0.0028	0.21	0.0076	0.0100	0.0014	0.10
Unknowns	0.0180	1.32	0.0514	0.1342	0.0164	1.21
TOTAL:	0.89	65.44	1.62	3.79	0.47	34.56

TABLE 9. HYDROCARBON EMISSIONS: 1978 MERCURY MONARCH, FUEL C

Compound	Tailpipe g/mi	% of THC	Evaporative Di,g	Evaporative HS,g	Evaporative Total g/mi	% of THC
Methane	0.1110	5.50				
Ethylene	0.0693	3.43				
Ethane	0.0331	1.64				
Acetylene	0.0438	2.17				
Propylene; propane	0.0287	1.42				
Propadiene	0.0006	0.03				
Methyl acethylene acetylene	0.0011	0.05				
Isobutane	0.0267	1.32	1.8239	0.4460	0.1076	5.33
Butene 1; isobutylene	0.0170	0.84	0.1680	0.0373	0.0109	0.54
N-butane; 1, 3-butadiene	0.2224	11.01	6.9267	1.1734	0.3746	18.54
Trans-2-butene	0.0103	0.51	0.1955	0.0354	0.0111	0.55
Cis-2-butene	0.0066	0.33	0.1156	0.0237	0.0069	0.34
3-methyl-1-butene	0.0017	0.08	0.0159	0.0071	0.0014	0.07
Isopentane	0.0886	4.39	0.7587	0.3946	0.0695	3.44
Pentene-1	0.0042	0.21	0.0288	0.0200	0.0032	0.16
N-pentene; 2-methyl-1-butene	0.0404	2.00	0.2437	0.1678	0.0267	1.32
Trans-2-pentene	0.0084	0.42	0.0459	0.0413	0.0062	0.31
Cis-2-pentene	0.0122	0.60	0.0478	0.0539	0.0077	0.38
2,2 Dimethylbutane	0.0037	0.18	0.0202	0.0083	0.0015	0.08
Cyclopentene	0.0019	0.09	0.0038	0.0060	0.0008	0.04
Cyclopentane; 3-methyl-1-pentene	0.0075	0.37	0.0233	0.0319	0.0044	0.21
2,3-dimethylbutane	0.0104	0.51	0.0207	0.0317	0.0043	0.22
2-methylpentane; 2,3-dimethly-1-butene	0.0271	1.34	0.0470	0.0806	0.0107	0.53
3-methylpentane	0.0163	0.81	0.0235	0.0443	0.0059	0.29
1-hexene; 2-ethyl-1-butene	0.0025	0.12	0.0051	0.0094	0.0013	0.06
N-hexane; Cis-3-hexene	0.0114	0.56	0.0141	0.0313	0.0039	0.19
2 methyl-2-pentene	0.0043	0.21	0.0069	0.0141	0.0019	0.09
Methylcyclopentane; 3-methyltrans-2-pentene	0.0154	0.76	0.0185	0.0408	0.0053	0.26
2,4-dimethylpentane	0.0107	0.53	0.0104	0.0212	0.0028	0.14
Methylcyclopentene	--	--	0.0003	0.0007	0.0002	0.01
Benzene	0.0335	1.66	0.0142	0.0356	0.0045	0.22
Cyclohexene; 2,3-dimethylpentane; 2-methylhexane	0.0286	1.42	0.0242	0.0515	0.0068	0.34
3-methylhexane, cyclohexane	0.0187	0.93	0.0151	0.0321	0.0041	0.20
Isooctane	0.0488	2.42	0.0440	0.0690	0.0092	0.46
N-heptane	0.0097	0.48	0.0101	0.0179	0.0023	0.11
2,4,4 Trimethyl-1-pentene	0.0020	0.10	0.0031	0.0057	0.0008	0.04
Methylcyclohexane	0.0070	0.35	0.0054	0.0110	0.0014	0.07
1 Cis-4-dimethylcyclohexane	0.0014	0.07	0.0008	0.0027	0.0003	0.01
2,4 and 2,5-dimethylhexane	0.0140	0.69	0.0122	0.0196	0.0026	0.13
2,3,4-trimethylpentane	0.0234	1.16	0.0191	0.0219	0.0029	0.14
2,3,3-trimethylpentane	0.0119	0.59	--	0.0108	0.0029	0.14
Toluene; 2,3-dimethylhexane	0.0526	2.60	0.0377	0.1059	0.0126	0.62
2-methylheptane	0.0103	0.51	0.0076	0.0121	0.0016	0.08
3-methylheptane	0.0089	0.44	0.0067	0.0098	0.0014	0.07
2,2,5-trimethylhexane	0.0088	0.44	0.0062	0.0084	0.0011	0.05
N-octane	0.0067	0.33	0.0036	0.0040	0.0007	0.03
2,3,5-trimethylhexane	0.0014	0.07	0.0007	0.0015	0.0002	0.01
2,4-dimethylheptane	0.0017	0.08	0.0007	0.0015	0.0002	0.01
2,5 and 3,5-dimethylheptane	0.0023	0.11	0.0005	0.0017	0.0002	0.01
Ethylbenzene; 2,3-dimethylheptane	0.0109	0.54	0.0052	0.0145	0.0019	0.09
P-xylene; x-xylene; 4-methyloctane	0.0340	1.68	0.0195	0.0518	0.0065	0.32
3 methyl octane	0.0006	0.03	--	--	--	--
O-xylene; unk C_9 paraffin	0.0149	0.74	0.0096	0.0195	0.0025	0.12
Nonane	0.0029	0.14	0.0030	0.0024	0.0004	0.02
N-propylbenzene	0.0048	0.24	0.0037	0.0040	0.0005	0.02
1-methyl 3-ethyl-benzene; unk C_{10}paraffin	0.0165	0.82	0.0108	0.0221	0.0029	0.14
1-methyl 2-ethyl benzene	--	--	--	--	--	--
Mesitylene	0.0090	0.45	0.0072	0.0122	0.0017	0.08
2,6 dimethyl octane	0.0084	0.42	0.0073	0.0110	0.0015	0.07
1,2,4-trimethylbenzene	0.0154	0.76	0.0128	0.0210	0.0029	0.14
Secbutylbenzene; n-decane	0.0024	0.12	0.0026	0.0046	0.0006	0.03
Unknowns	0.0293	1.45	0.0420	0.0535	0.0075	0.37
TOTAL:	1.27	62.87	10.93	3.36	0.75	37.13

TABLE 10. HYDROCARBON EMISSIONS: 1979 FORD LTD-II, FUEL B

Compound	Tailpipe g/mi.	% of THC	Evaporative Di,g	Evaporative HS,g	Total g/mi	% of THC
Methane	0.1236	15.65				
Ethylene	0.0181	2.29				
Ethane	0.0142	1.80				
Acetylene	0.0040	0.51				
Propylene; propane	0.0076	0.96				
Propadiene	0.0004	0.05				
Methyl acethylene acetylene	0.0003	0.04				
Isobutane	0.0033	0.42	0.1038	0.0284	0.0073	0.92
Butene 1; isobutylene	0.0054	0.68	0.0410	0.0062	0.0023	0.29
N-butane; 1, 3-butadiene	0.0141	1.78	0.6244	0.1283	0.0389	4.92
Trans-2-butene	0.0016	0.20	0.0314	0.0110	0.0024	0.30
Cis-2-butene	0.0014	0.18	0.0217	0.0092	0.0019	0.24
3-methyl-1-butene	0.0004	0.05	0.0037	0.0030	0.0005	0.06
Isopentane	0.0276	3.49	0.3773	0.3028	0.0464	5.87
Pentene-1	0.0006	0.08	0.0106	0.0093	0.0014	0.18
N-pentene; 2-methyl-1-butene	0.0072	0.91	0.0906	0.0908	0.0131	1.66
Trans-2-pentene	0.0017	0.22	0.0249	0.0257	0.0036	0.46
Cis-2-pentene	0.0033	0.42	0.0378	0.0405	0.0057	0.72
2,2 Dimethylbutane	0.0008	0.10	0.0037	0.0038	0.0006	0.08
Cyclopentene	0.0005	0.06	0.0041	0.0050	0.0007	0.09
Cyclopentane; 3-methyl-1-pentene	0.0013	0.16	0.0114	0.0228	0.0029	0.37
2,3-dimethylbutane	0.0031	0.39	0.0263	0.0281	0.0039	0.49
2-methylpentane; 2,3-dimethly-1-butene	0.0077	0.97	0.0562	0.0656	0.0090	1.14
3-methylpentane	0.0040	0.51	0.0256	0.0318	0.0043	0.54
1-hexene; 2-ethyl-1-butene	0.0009	0.11	0.0079	0.0106	0.0014	0.18
N-hexane; Cis-3-hexene	0.0019	0.24	0.0138	0.0118	0.0018	0.23
2 methyl-2-pentene	0.0016	0.20	0.0123	0.0189	0.0024	0.30
Methylcyclopentane; 3-methyltrans-2-pentene	0.0035	0.44	0.0196	0.0314	0.0041	0.52
2,4-dimethylpentane	0.0018	0.23	0.0115	0.0128	0.0018	0.23
Methylcyclopentene	—	—	—	—	—	—
Benzene	0.0244	3.09	0.0302	0.0539	0.0068	0.86
Cyclohexene; 2,3-dimethylpentane; 2-methylhexane	0.0045	0.57	0.0212	0.0271	0.0037	0.47
3-methylhexane, cyclohexane	0.0033	0.42	0.0112	0.0172	0.0023	0.29
Isooctane	0.0094	1.19	0.0227	0.0558	0.0068	0.86
N-heptane	0.0021	0.27	0.0045	0.0168	0.0021	0.27
2,4,4 Trimethyl-1-pentene	0.0005	0.06	0.0009	0.0049	0.0006	0.08
Methylcyclohexane	0.0017	0.22	0.0047	0.0109	0.0013	0.16
1 Cis-4-dimethylcyclohexane	0.0002	0.03	N/A	0.0016	0.0002	0.03
2,4 and 2,5-dimethylhexane	0.0038	0.48	0.0053	0.0204	0.0024	0.30
2,3,4-trimethylpentane	0.0111	1.41	0.0106	0.0496	0.0057	0.72
2,3,3-trimethylpentane	—	—	—	—	—	—
Toluene; 2,3-dimethylhexane	0.0763	9.66	0.1845	0.5711	0.0673	8.52
2-methylheptane	0.0018	0.23	0.0046	0.0148	0.0017	0.22
3-methylheptane	0.0011	0.14	0.0051	0.0091	0.0011	0.14
2,2,5-trimethylhexane	0.0054	0.68	0.0104	0.0211	0.0026	0.33
N-octane	0.0018	0.23	0.0060	0.0077	0.0010	0.13
2,3,5-trimethylhexane	0.0009	0.11	0.0019	0.0029	0.0004	0.05
2,4-dimethylheptane	0.0002	0.03	0.0013	0.0012	0.0002	0.03
2,5 and 3,5-dimethylheptane	0.0004	0.05	0.0006	0.0019	0.0002	0.03
Ethylbenzene; 2,3-dimethylheptane	0.0052	0.66	0.0053	0.0226	0.0026	0.33
P-xylene; x-xylene; 4-methyloctane	0.0119	1.51	0.0181	0.0676	0.0078	0.99
3 methyl octane	—	—	—	—	—	—
O-xylene; unk C_9 paraffin	0.0058	0.73	0.0077	0.0296	0.0034	0.43
Nonane	0.0010	0.13	0.0026	0.0035	0.0005	0.06
N-propylbenzene	0.0023	0.29	0.0055	0.0136	0.0016	0.20
1-methyl 3-ethyl-benzene; unk C_{10}paraffin	0.0109	1.38	0.0163	0.0637	0.0074	0.94
1-methyl 2-ethyl benzene	—	—	—	—	—	—
Mesitylene	0.0043	0.54	0.0055	0.0253	0.0029	0.38
2,6 dimethyl octane	0.0036	0.46	0.0052	0.0210	0.0024	0.30
1,2,4-trimethylbenzene	0.0119	1.51	0.0165	0.0699	0.0081	1.03
Secbutylbenzene; n-decane	0.0024	0.30	0.0352	0.0155	0.0024	0.30
Unknowns	0.0099	1.25	0.0418	0.0617	0.0082	1.04
TOTAL:	.48	60.77	2.05	2.18	.31	39.30

TABLE 11. HYDROCARBON EMISSIONS: 1979 FORD LTD-II, FUEL C

Compound	Tailpipe g/mi	% of THC	Evaporative Di,g	HS,g	Total g/mi	% of THC
Methane	0.2081	7.18				
Ethylene	0.0245	0.84				
Ethane	0.0040	0.13				
Acetylene	0.0232	0.80				
Propylene; propane	0.0081	0.28				
Propadiene	0.0002	0.01				
Methyl acethylene acetylene	0.0003	0.01				
Isobutane	0.0036	0.12	3.0509	1.0894	0.2251	7.76
Butene 1; isobutylene	0.0041	0.14	0.4195	0.1388	0.0299	1.03
N-butane; 1, 3-butadiene	0.0336	1.16	17.6133	6.0904	1.284	44.29
Trans-2-butene	0.0013	0.05	0.5606	0.1819	0.0397	1.37
Cis-2-butene	0.0011	0.04	0.3476	0.1142	0.0249	0.85
3-methyl-1-butene	0.0003	0.01	0.0693	0.0246	0.0050	0.17
Isopentane	0.0201	0.69	3.6357	1.4473	0.2870	9.90
Pentene-1	0.0005	0.02	0.1455	0.0609	0.0117	0.40
N-pentene; 2-methyl-1-butene	0.0097	0.33	0.7477	0.5448	0.0882	3.04
Trans-2-pentene	0.0012	0.04	0.2470	0.1084	0.0206	0.71
Cis-2-pentene	0.0019	0.07	0.3102	0.1410	0.0263	0.91
2,2 Dimethylbutane	0.0015	0.05	0.0694	0.0328	0.0060	0.21
Cyclopentene	0.0003	0.01	0.0433	0.0165	0.0033	0.12
Cyclopentane; 3-methyl-1-pentene	0.0021	0.07	0.1383	0.0643	0.0117	0.40
2,3-dimethylbutane	0.0033	0.11	0.1995	0.0975	0.0177	0.61
2-methylpentane; 2,3-dimethly-1-butene	0.0079	0.27	0.4942	0.2508	0.0449	1.55
3-methylpentane	0.0055	0.19	0.2415	0.1252	0.0222	0.77
1-hexene; 2-ethyl-1-butene	0.0006	0.02	0.0498	0.0264	0.0045	0.16
N-hexane; Cis-3-hexene	0.0037	0.12	0.1150	0.0659	0.0112	0.39
2 methyl-2-pentene	0.0014	0.05	0.0619	0.0355	0.0060	0.21
Methylcyclopentane; 3-methyltrans-2-pentene	0.0043	0.15	0.1227	0.0729	0.0122	0.42
2,4-dimethylpentane	0.0036	0.12	0.0954	0.0559	0.0096	0.33
Methylcyclopentene	--	--	--	--	--	--
Benzene	0.0142	0.49	0.1064	0.0787	0.0122	0.42
Cyclohexene; 2,3-dimethylpentane; 2-methylhexane	0.0084	0.29	0.2001	0.1264	0.0210	0.73
3-methylhexane, cyclohexane	0.0057	0.20	0.1057	0.0699	0.0115	0.40
Isooctane	0.0165	0.56	0.3534	0.1524	0.0368	1.27
N-heptane	0.0026	0.09	0.0644	0.0457	0.0074	0.26
2,4,4 Trimethyl-1-pentene	0.0004	0.01	0.0099	0.0080	0.0012	0.04
Methylcyclohexane	0.0019	0.07	0.0294	0.0220	0.0033	0.12
1 Cis-4-dimethylcyclohexane	0.0003	0.01	0.0033	0.0023	0.0005	0.02
2,4 and 2,5-dimethylhexane	0.0041	0.14	0.0626	0.0462	0.0074	0.26
2,3,4-trimethylpentane	0.0081	0.28	0.0329	0.0650	0.0084	0.29
2,3,3-trimethylpentane	--	--	0.0539	--	0.0041	0.14
Toluene; 2,3-dimethylhexane	0.0142	0.49	0.1145	0.1865	0.0241	0.83
2-methylheptane	0.0024	0.08	0.0177	0.0213	0.0031	0.11
3-methylheptane	0.0023	0.08	0.0131	0.0180	0.0024	0.08
2,2,5-trimethylhexane	0.0022	0.08	0.0191	0.0194	0.0029	0.10
N-octane	0.0026	0.09	0.0079	0.0122	0.0017	0.06
2,3,5-trimethylhexane	0.0004	0.01	0.0016	0.0024	0.0005	0.02
2,4-dimethylheptane	0.0004	0.01	0.0007	0.0023	0.0002	0.01
2,5 and 3,5-dimethylheptane	0.0011	0.04	0.0011	0.0028	0.0005	0.02
Ethylbenzene; 2,3-dimethylheptane	0.0028	0.10	0.0061	0.0140	0.0017	0.06
P-xylene; x-xylene; 4-methyloctane	0.0103	0.35	0.0214	0.0457	0.0057	0.20
3 methyl octane	--	--	--	--	--	--
O-xylene; unk C_9 paraffin	0.0045	0.16	0.0084	0.0193	0.0024	0.08
Nonane	0.0016	0.06	0.0093	0.0050	0.0007	0.02
N-propylbenzene	0.0015	0.05	0.0049	0.0078	0.0010	0.03
1-methyl 3-ethyl-benzene; unk C_{10}paraffin	0.0048	0.17	0.0101	0.0305	0.0036	0.12
1-methyl 2-ethyl benzene	--	--	--	--	--	--
Mesitylene	0.0030	0.10	0.0065	0.0162	0.0019	0.07
2,6 dimethyl octane	0.0016	0.05	0.0058	0.0156	0.0019	0.07
1,2,4-trimethylbenzene	0.0042	0.15	0.0101	0.0319	0.0038	0.13
Secbutylbenzene; n-decane	0.0016	0.05	0.0042	0.0088	0.0012	0.04
Unknowns	0.0090	0.30	0.2373	0.1495	0.0249	0.86
TOTAL:	0.51	17.64	30.3	12.1	2.39	82.46

Ambient temperatures during the vehicle tests were typical of summer conditions (68°-86°F). A reasonable fuel vapor pressure for this temperature range would be 9.8 lb Reid Vapor Pressure (RVP)(4). Thus, fuel B would give evaporative emission rates typical for current summer fuels. The historical trend has been to increased fuel vapor pressure, however, and the other test fuels were included primarily to examine the sensitivity of evaporative emissions to fuel vapor pressure.

The 1963 Chevrolet evaporative emissions were examined only with 12.8 lb RVP gasoline. It has been estimated that evaporative emissions would decrease about 1/3 from this vehicle if fueled with 9.8lb RVP gasoline (2). It should also be noted that the 1977 Mustang-II was operating under richer fuel-air conditions than normal certification carburetor tune. This model year passenger car was certified at 1.5 grams/mile tailpipe hydrocarbon emissions, as compared to 2.8 grams/mile observed with this vehicle.

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